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FLIGHT SPEED OF BIRDS

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INTRODUCTION

A bird's power of flight is one of its most fascinating characteristics and one that from the earliest times has stirred man's imagination and aroused his envy. One of the writers of the Book of Proverbs found "the way of an eagle in the air" too wonderful for his comprehension. Today, by calling mechanics to his aid, man has achieved the power to travel "as the crow flies"; and although the aviator is still much less independent in the air than the birds he seeks to emulate, we are indebted to him, nevertheless, for much information regarding the flight of birds.

Three phases of bird flight have been the subject of much conjecture and investigation, namely, the speed of flight, the altitude of the migratory flights, and, especially in recent years, the mechanics or aeronautics of flight. It is the purpose of the present circular to deal principally with the first, speed of flight, though reference is made to the other two phases in the text and titles of articles dealing with them are included in the bibliography, which gives also the authority for all records of speed given in the table (p. 6).

ESTIMATED SPEEDS

Many years ago Gätke (*27*),[1] reporting his observations of migratory birds on the island of Helgoland in the North Sea, expressed his belief that even small birds in migration travel at speeds as great as 3 or 4 miles a minute. His figures were based on the false premises that birds made the trip from winter to summer home, or the reverse, in a single flight of a few hours and that they were able to do this by flying thousands of feet, even several miles, above the earth, where the rarefied air offered less resistance. Aviators now tell us that at great altitudes the lessened buoyancy of the air makes flight more instead of less difficult.

[1] Italic numbers in parentheses refer to the bibliography, p. 10.

The speed of birds, especially of game birds, has been greatly exaggerated, both in literature and in popular thought, because it has usually been computed from estimates rather than from exact measurements; and the most reliable of these estimates has been based on the estimated distance of the bird from the hunter, the estimated "lead" necessary to hit the bird—that is, the distance traveled by the bird from the time the gun was fired until the bird was struck by the shot—and the time required for the shot to travel from the gun to the bird. If all three factors were known exactly, the speed of the bird could be accurately computed, but, unfortunately, only the velocity of the shot is definitely known. Also it has been found recently by experiment that there is an appreciable loss of time in pulling the trigger. Against the sky it is practically impossible to gage the exact distance of the bird, and the distance it travels may be exaggerated because momentum will carry a shot bird some distance before it falls. As can be readily understood, an overestimate of a very few feet in these figures will result in the computation of a series of very high speeds for game birds, which many persons have believed possible. Gunners (possibly actuated in part by a subconscious feeling of personal vanity), especially, have been prone to attribute speeds of 75, 100, or even 150 miles an hour to ducks—they missed.

MEASURED SPEEDS

In the last quarter of a century the effort to ascertain the facts on the speed of avian flight has resulted in the publication of many scattered notes and some extensive papers. Stop watches and theodolites have been used to time birds flying across measured distances, and the automobile speedometer and the air-speed indicator of the airplane have furnished many reliable records. These data are demonstrating that the earlier estimates of bird speed were too high and that some birds, especially the song and insectivorous species, are rather slow flyers.

Most persons are less interested in air speed than in ground speed. Air speed is the rate at which a bird moves through the air by its own effort, no allowance being made for the influence of the wind. Ground speed is the velocity of the actual progress of the bird between two points, or the air speed accelerated or retarded by the influence of the wind and other atmospheric conditions. Undoubtedly, the air speeds of different birds are much more comparable than ground speeds, since variables other than the flying ability of the individuals are reduced to a minimum. Air speeds are difficult to obtain, however, since the only means is by the air-speed indicator of airplanes, and the stalling speed of most airplanes is higher than the maximum possible for any but the fastest flying species. Most records thus obtained are of birds chased and indicate, therefore, the greatest speed of which the birds were capable; the "stalling speed" of birds will forever remain a matter of conjecture. The ground speed, however, can be measured more readily, though it is subject to much variation, and the conditions under which observations are made vary so greatly that two records, even for the same species, are seldom entirely comparable.

VARIATIONS IN SPEED

No hard and fast rules can be laid down as to bird speeds, not even for any given species, since the individual variation is considerable.

For example, Portal (*55*), in 1922, noted that one partridge of a covey flew 15 percent faster than the others when all were in full flight before a falcon. The age of the bird, the state of its plumage, and other physical conditions modify its powers of flight and thus affect its speed. Variation in speed, as stated above, is caused also by the force of the wind and other atmospheric conditions.

Moreover, it is only in level flight that birds can be timed or their speeds compared, since even a slight angle downward adds greatly to the velocity. It is practically impossible to time the speed of ducks darting down to the water, the stoop of a hawk, or the swoop of a swift. Some falconers have estimated that when a peregrine strikes its prey it is traveling at the rate of 150 miles an hour. An aviator has related that on one occasion when he was diving at a flock of ducks at a velocity of nearly 175 miles an hour, a hawk (presumably a duck hawk) passed him "as though the plane were standing still" and struck one of the ducks. In this connection it is interesting to note that aviators report that ducks, when pressed, accelerate considerably, possibly increasing their speed by a third, but that geese are able to accelerate very little.

EFFECT OF WINGS AND WEIGHT

The size and shape of the wings in comparison with the weight of a bird are important factors in determining its speed of flight. The smaller the wings in proportion to the weight, the greater will be the speed required for the bird to maintain its position in the air. More rapid wingbeats against the supporting atmosphere are necessary for a bird with a small wing surface than for one with a wing surface great enough for it to take full advantage of ascending air currents. The short-winged loon has much difficulty in raising its heavy body from the water, but once it is in the air, its rapid wingbeats carry it away at great speed, whereas the turkey vulture, with its long, broad wings and light body can rise easily and sail lazily on the air without any detectable wing movement. The loon, which weighs more than 8 pounds, has a wing expanse of about 55 inches, but the turkey vulture, with only a 4-pound body weight, is supported by a wingspread of about 70 inches. Although the weights of the mallard and canvasback are nearly the same, the wing surface of the slow-flying mallard is about 20 percent greater than that of the swifter canvasback, the latter making up for this smallness of supporting surface by the rapidity of its wingbeats, aided probably also by a reduction of air resistance because of its more streamlined build.

It is generally conceded that when two birds of a similar type are once in the air, the heavier bird is the faster. The quicker rise and get-away of the smaller bird, the teal, for example, gives a false impression of speed. Radclyffe (*59*), an experienced falconer, in England, related that he had often flown a peregrine over mixed flocks of teals and mallards and flushed the birds simultaneously. In every case, the first bird overhauled by the hawk was a teal; and in case of a long flight, when every bird was flying for its life, the farther the birds went, the more the teal lagged behind. Munson (*51*) reported that while chasing ducks with an airplane, he twice saw bunches of green-winged teals that were easily outflown by canvasbacks in the same flock.

In comparing birds of dissimilar types, rapid wingbeats or erratic flight sometimes give the erroneous impression of great velocity. A black-headed gull with deliberate wingbeat was noted (*41*) almost to keep pace with a golden plover whose rapidly moving wings made it appear much swifter. The seeming speed of the swallow is partly due to its constant twisting and turning.

INFLUENCE OF WIND

Wind causes wide variation in the speed of bird flight, even of different individuals of the same species. Probably most of the high-speed records are of birds driven by the wind, but to consider that a bird's progress over the earth will be at the rate of its air speed plus or minus the exact force of the wind can hardly be correct. Brown pelicans were repeatedly timed (*66*) along the beach near El Pismo, Calif. The birds were flying south and the prevailing wind was from the northeast. With practically no wind, their speed was only 14 miles an hour; with "half a gale" blowing, it increased to only 16 miles an hour; and when the velocity of the wind reached 50 miles an hour, it rose to but 22 miles an hour.

The explanation is that in order for a bird to remain aloft it must rest on a current of air against the under side of its wings, and this current must come from the front, not from behind, the backward tilt of the wings catching this wind. These facts are well recognized in modern aeronautics. Both birds and airplanes must take off and land into the wind. Therefore, if the wind is directly behind, the bird must move its wings faster in order to get the necessary upbearing current or else be blown along by the wind without being able to guide its course. Gulls are frequently seen drifting with a ship on the windward side, borne along with almost motionless wings on the updraft of air from the wind striking against that side of the ship, although the birds on the other side, where the draft is downward, must flap their wings steadily. Birds dislike to fly directly with the wind and direct their course so as to have the wind at one side or even to fly directly into it. An Army homing pigeon, in many trial flights, made its maximum speed of a mile a minute only when helped by a quartering tail wind.

That birds are sometimes unable to cope with the wind is indicated by the many records ("accidental occurrences") of birds far from their normal range, following storms. Usually such records are for a few individuals only, but late in December 1927 hundreds of lapwings appeared in Newfoundland. The lapwing is a European species of which less than a dozen individuals had previously been recorded in North America. Among the birds captured at that time was one that had been banded in northern England, indicating the probable source of many of these birds. Witherby (*82*), in his study of this event, stated that the birds probably headed southwestward for southern Ireland but that an east wind stronger than their power of flight was at that time blowing across the North Atlantic and doubtless drove the birds far beyond their intended destination. B. (*11*), an observer in England, tells of seeing rooks helpless against a strong wind, as they attempted to reach their roost, some being blown sideways and some tail first and one turning a series of somersaults head over tail, when a wedge of pink-footed geese passed, flying low into the gale. The geese rolled heavily from side to side but kept straight on their

course at a great rate of speed as though the force of the wind made little difference to them. Many incidents have been recorded of birds on migration that apparently waited for a favorable wind to help them on their way; or, at any rate, until an adverse one was past.

It is popularly supposed that birds in migration climb until they find a favoring wind, sometimes to great altitudes. Aviators report that it is exceptional to see any birds more than 5,000 feet above the earth and that few are seen above 3,000 feet. There are, however, records of birds seen at very high altitudes above sea level, but these are mostly in mountainous country where the birds are flying at comparatively short distances above the land. Under normal weather conditions some species regularly fly low, whereas others invariably fly high; in bad weather most birds fly low, as shown by their striking against lighthouses and high buildings.

The evidence thus far obtained indicates that the greater part of migration takes place below 3,000 feet above the earth's surface, much of it below 1,000 feet, and that birds prefer to fly below the level of the clouds. The definite observations are of daytime migrations, but there is no reason to suppose that birds fly any higher by night than by day. Furthermore, what man considers a favoring wind may not be chosen by the birds. An aviator (*56*) tells of flying with a large flock of lapwings in northern France at an altitude of 5,500 feet. The birds were flying due north into a strong wind at an air speed of about 50 miles an hour but were not making more than 20 miles an hour headway, while on the ground the wind was from the south at about 5 miles an hour, and at 3,000 feet it was northwest at a little over 30.

Birds on migration must take the rate of speed that can be maintained for the longest time with the greatest economy of effort. On occasion, however, most birds can considerably increase this speed. Meinertzhagen (*49*), as a result of his study of the available information, came to the conclusion that—

> birds have two speeds—a normal rate which is used for everyday purposes and also for migration, and an accelerated speed which is used for protection or pursuit, and which in some cases nearly doubles the rate of their normal speed.

Since his paper was published in 1921, many additional data have been gathered, especially relative to the song and insectivorous species. From these it seems that the short daily flights are subject to much variation in speed but are often quite slow and that the flight of birds coming to their roosts toward evening is faster and seems to be comparable with that used in migration.

TABLE OF SPEEDS

In table 1 are given all the speed-of-flight records at hand of North American species and also of a few European species that have occurred in North America and are included because the birds are closely related to North American species for which no records are available. A few running speeds are added as a matter of interest. The species are arranged in the order of the American Ornithologists' Union Check List of North American Birds (4th ed. 1931). The source of all the material summarized in the table is given in the bibliography, with the exception of the few items in which the authors' names are followed by initials, which are manuscript records of the Biological Survey.

TABLE 1.—*Recorded speeds of some North American and European birds*

[Under timing device, "automobile" means automobile speedometer; "airplane", air-speed indicator of an airplane]

FLYING SPEEDS

Species	Miles per hour	Timing device	Place	Authority	Remarks
Brown pelican	26	Automobile	Florida	Longstreet (*44*)	4 birds, 8 miles, wind abeam.
Do	14–22	do	California	Smith (*66*)	Speed varied with force of wind.
Gannet	25	do	Florida	Longstreet (*44*)	4 birds, wind ahead.
Do	30	do	do	Chapman (*19*)	
Do	48	Airplane	England	Meinertzhagen (*49*).	Air speed.
European cormorant.	27, 35	Automobile	do	Roberts (*63*)	Faster bird alarmed but not chased.
Florida cormorant	20	do	Florida	Longstreet (*44*)	4 birds, wind ahead.
Great blue heron	28	do	California	Wetmore (*77*)	2 observations.
Do	23	do		Wood (*84*)	
American egret	17	do		do. (*84*)	
Green heron	34	do	California	McLean (*45*)	Easy flight, no wind.
Do	22	do		Wood (*84*)	
Whistling swan	30	do	Pennsylvania	do. (*ms*)	
Do	50–55	Airplane	do	Weiser (*76*)	Air speed, top speed, flock timed about 15 minutes, 1,400 feet altitude.
Do	45	do	California	Munson (*50*)	Air speed, chased.
Canada goose	44.3	Theodolites	Massachusetts.	Clayton (*22*)	Light wind.
Do	60	Airplane	California	Kelsey, J. V.	Air speed, chased, could maintain speed only short time.
Cackling goose	45–55+	Automobile	Washington	Rathbun (*61*)	Flock, 3 miles.
Brant	45	Airplane	Scotland	Meinertzhagen (*49*).	Air speed.
Snow goose	50±	do	California	Munson (*50*)	Air speed, chased.
Ducks (sp. ?)	47.5	Kites and stopwatch.	New Jersey	R. (*58*)	Average of 20 observations.
Do	47.8	Theodolites	Massachusetts.	Clayton (*21*)	Light wind.
Mallard	58		England	Portal (*55*)	Average maximum level flight through still air.
Do	46±	Airplane	do	Wicks (*79*)	Air speed, increased speed as plane approached.
Do	60	do	California	Kalmbach, E. R.	Air speed, 10 miles across Salton Sea.
Do	55±	do	do	Munson (*50*)	Air speed, chased.
Do	50	do		Meinertzhagen (*49*).	Air speed.
Do	50	do	France	do. (*49*)	Do.
Black duck	28	Automobile		Wood (*84*)	
Pintail	52+	Train	Arizona	Grinnell (*31, p. 509*).	Flock flew parallel to train.
Do	65±	Airplane	California	Munson (*50*)	Air speed, chased.
European teal	68	do	England	Wicks (*80*)	Air speed, 2 pairs chased.
Cinnamon teal	32, 39	Automobile	California	McLean (*45*)	First speed easy flight; increased to second speed when chased. Another bird flew 49.
Shoveler	47, 53	do	do	do. (*45*)	2 observations, easy flight.
Redhead	42	Train	Colorado	Ritter (*69*)	Flock in sight for 50 miles.
Canvasback	72±	Airplane	California	Munson (*50*)	Air speed, chased.
Goldeneye	50−	Train	New York	R. (*58*)	Train in one-half mile passed flock that had been shot at.
Turkey vulture	21	do	Missouri	Anonymous (*3*).	
Do	15	Automobile		Wood (*84*)	
Red-tailed hawk	22	do	California	Wetmore (*77*)	
Swainson's hawk	15	do	Kansas	Wood (*83*)	
Eagle (sp. ?)	60	Train	Missouri	Anonymous (*3*).	
Golden eagle	120	Watch	Scotland	Darling (*24*)	Chased by peregrines.
Bald eagle	30	Automobile		Bennett, W. W.	Carrying a fish weighing about 2 pounds.
Peregrine falcon	62		England	Portal (*55*)	Average maximum level flight through still air.
Do	36.8	Stop watch	Germany	Thienemann (*69*)	Easy flight.
Duck hawk	165–180	do	California	McLean (*45*)	Hunting.
Duck hawk (probably).	175+	Airplane	Texas	Lawson (*42*)	Air speed, stooping to quarry.
Sparrow hawk	22, 25	Automobile	California	Wetmore (*77*)	2 observations.
Ruffed grouse	22	do	New England	White (*78, p. 46*).	
Sharp-tailed grouse	33	do	Minnesota	Anonymous (*7*).	For 1½ miles.

TABLE 1.—*Recorded speeds of some North American and European birds*—Contd.

FLYING SPEEDS—Continued

Species	Miles per hour	Timing device	Place	Authority	Remarks
European partridge.	53	----------	England	Portal (*55*)	Average maximum level flight through still air.
Do	27	Automobile	do	Pitt (*54*)	
Do	27.6–32.1	Stop watch	do	Anonymous (*1*)	
Do	41	Automobile	do	Harrisson (*33*)	Chased by car.
Do	40	Airplane	----------	Meinertzhagen (*49*).	Air speed.
Do	25–35	Automobile	England	Roberts (*63*)	5 observations, ordinary flight.
Do	40	do	do	do. (*63*)	Chased by car.
Bobwhite	48	Stop watch	South Carolina.	Anonymous (*6*)	Birds flushed, top speed.
Do	49	Automobile	----------	Huntington (*37*)	Bird frightened.
Do	28–38	----------	Georgia	Stoddard (*68, p. 51*).	Mature birds, many tests in all types of wind.
California quail	39, 51	Automobile	California	McLean (*46*)	Faster bird badly frightened.
Valley quail	38–58	do	do	do. (*46*)	3 observations.
Gambel's quail	41	do	do	do. (*46*)	300 feet, somewhat frightened.
Pheasant	60	----------	England	Portal (*55*)	Average maximum level flight through still air.
Do	27–38	Stop watch	do	Anonymous (*1*)	3 observations.
Turkey	55	Automobile	----------	Kanoy (*40*)	Paced 1 mile, urged on by horn.
Lapwing	37	Theodolites	Palestine	Meinertzhagen (*49*).	Single bird against head wind of 12 m. p. h., 860 feet altitude.
Do	42	do	France	do. (*49*)	Altitude 1,410 feet.
Do	40, 45	Airplane	do	do. (*49*)	Air speed.
Do	50	do	do	Portal (*56*)	Air speed, 5,500 feet, altitude.
Do	28, 33	Automobile	England	Roberts (*63*)	Zigzag flight and somersault.
Do	41	do	do	do. (*63*)	Flock migrating.
Do	30–40	do	do	Harrisson (*32, 33*).	4 records, all easy flight, 24 m. p. h. planing to ground at 45° angle.
Semipalmated plover.	32	do	Florida	Longstreet (*44*)	Wind behind.
Killdeer	28–55+	do	California	McLean (*45*)	
European golden plover.	60	Airplane	England	Meinertzhagen (*49*).	Air speed, birds pressed.
Do	70	----------	do	Portal (*55*)	Average maximum level flight through still air.
American golden plover.	60+	Train	Illinois	Martin (*47*)	Easily passed train going 58 to 62 m. p. h.
Do	70	Automobile	Iowa	Youngworth (*86*)	Flock of 30 for a mile. Apparently not unusual speed.
Black-bellied plover.	24	do	Florida	Longstreet (*44*)	Wind abeam.
Ruddy, turnstone	27	do	do	do. (*44*)	4 birds, wind ahead.
Do	33	do	North Carolina.	Howell, A. H.	
Woodcock	5	do	New England	White (*78, v. 50*)	
Do	13	do	----------	Wood (*84*)	
Long-billed curlew	35	do	----------	Jones (*39*)	
Hudsonian curlew	34	do	Florida	Longstreet (*44*)	2 birds, 7 miles, wind abeam.
Willet	27	do	do	do. (*44*)	Wind ahead.
Knot	38	do	do	do. (*44*)	Flock, wind abeam.
Long-billed dowitcher.	43	do	California	McLean (*45*)	5 birds.
Semipalmated sandpiper.	32	do	Florida	Longstreet (*44*)	Flock, wind abeam.
Western sandpiper	44, 52	do	California	McLean (*45*)	2 observations, level flight.
Sanderling	41	do	Florida	Longstreet (*44*)	Wind behind about 10 m. p. h.
Gulls (sp. ?)	30	do	California	Jones (*39*)	Flock of 12 timed one-half hour.
Do	25	Boat	Irish Sea	Gladstone (*29*)	Accompanied mail boat without effort.
Glaucous-winged gull.	20–28	Automobile	Washington	Rathbun (*61*)	
Great black-backed gull.	31.1	Stop watch	Germany	Thienemann (*69*)	
Herring gull	21–36	Automobile	England	Roberts (*63*)	4 observations.
Do	17–20	do	do	Harrisson (*33*)	3 observations, very easy flight.
Do	12	do	do	do. (*33*)	Planing near ground.

TABLE 1.—*Recorded speeds of some North American and European birds*—Contd.

FLYING SPEEDS—Continued.

Species	Miles per hour	Timing device	Place	Authority	Remarks
Ring-billed gull	35	Automobile	North Carolina.	Howell, A. H.	
Black-headed gull	21–30	do	England	Roberts (*63*)	4 observations.
Do	20, 21. 5	do	do	Harrisson (*33*)	Leisurely flight.
Common tern	15, 29	do	do	Roberts (*63*)	
Do	25, 27	do	do	Harrisson (*33*)	2 observations, easy flight.
Do	13	do		Wood (*84*)	
Black skimmer	18	do	Florida	Longstreet (*44*)	2 birds, 3 miles, wind ahead.
Mourning dove	30±	do	California	Bassett (*12*)	
Do	30–36	do	do	Tyler (*71*)	3 observations.
Do	32	do	Kansas	Wood (*84*)	
Do	40–41	do	California	Tonkin, G.	Parallel to car for 1 mile.
Do	26	do		Wood (*83*)	
Yellow-billed cuckoo.	22	do		do. (*84*)	
Nighthawk	12–22	do	Kansas	do. (*83*)	3 observations.
Ruby-throated hummingbird.	45	do	Pennsylvania	Hayes (*34*)	Easy flight.
Do	55±	do	Virginia	Allard (*9*)	Bird not frightened, apparently easy flight.
Belted kingfisher	36	do	California	McLean (*45*)	
Northern flicker	20, 25	do	New Hampshire.	White (*78, v. 44, 46*).	2 observations.
Do	23	do		Wood (*84*)	
Red-shafted flicker	27	do	California	Gignoux (*28*)	Bird surpised, doing its best.
Do	25	do	do	Wetmore (*77*)	
Do	43–44	do	do	McLean (*45*)	Startled.
Kingbird	15–23	do	New England.	White (*78, v. 46, 50*).	5 observations.
Do	11	do		Wood (*84*)	
Arkansas kingbird	17	do	Kansas	do. (*83*)	
Scissor-tailed flycatcher.	10	do	do	do. (*83*)	
Horned lark	23–28	do	California	Wetmore (*77*)	Several observations.
Do	32, 54	do	do	McLean (*45*)	2 observations.
Do	28	do	do	Tyler (*71*)	
Tree swallow	24	do	New England.	White (*78, v. 50*)	2 birds, stragglers from migrating flock.
Do	25	do		Wood (*84*)	
Bank swallow	31	do	England	Harrisson (*33*)	Chased by car.
Barn swallow	23	do	New England.	White (*78, v. 50*)	
Do	42–46	do	California	McLean (*45*)	
Do	20	do		Wood (*84*)	2 observations, same speed.
European swallow	23–32	do	England	Harrisson (*33*)	11 observations.
Do	37. 75	Theodolites	East Africa	Meinertzhagen (*49*).	In migration, wind calm, 235 feet.
Do	34	do	do	do (*49*)	In migration, strong head wind, near ground.
Do	25	Automobile	England	Wallis (*74*)	200 yards, ordinary flight, for food.
Do	25	Stop watch	do	Walker (*73*)	
Purple martin	20	Automobile		Wood (*84*)	
Blue jay	20	do	New England.	White (*78, v. 46*)	
Magpie	35	do	England	Roberts (*63*)	Chased.
Do	19	do	do	Harrisson (*33*)	40 yards.
Raven	24	do	California	Wetmore (*77*)	
Crow	25	Train	Missouri	Anonymous (*3*)	
Do	60—	do	New York	Martin (*47*)	Could just keep up to train going 58 to 62 m. p. h.
Do	25–32	Automobile	Washington	Rathbun (*61*)	Many observations.
Catbird	16	do	New England.	White (*78, v. 46*)	
Do	12	do		Wood (*84*)	
Brown thrasher	19, 22	do		do. (*84*)	2 observations.
Robin	20–32	do	New England.	White (*78*)	11 observations.
Do	36	do		Aymar (*10, p. 135*).	
Do	17–23	do		Wood (*84*)	3 observations.
Bluebird	17	do	New England.	do. (*84*)	2 observations, 1 carrying food, 1 without.
Shrike	32–45	do	Washington	Rathbun (*61*)	
Do	28	do	California	Wetmore (*77*)	
Starling	18	do	New England.	White (*78, v. 46*)	
Do	44		England	Portal (*55*)	Average maximum level flight through still air.
Do	31. 4	Stop watch	do	Wynne - Edwards (*85*).	Involving climb of 350 feet. No wind.

TABLE 1.—*Recorded speeds of some North American and European birds*—Contd.

FLYING SPEEDS—Continued.

Species	Miles per hour	Timing device	Place	Authority	Remarks
Starling	30–45	Automobile	England	Pitt (*54*)	
Do	32	do	do	Brown (*13*)	
Do	24+	do	do	Ticehurst (*70*)	Gained on car going 24 m. p. h.
Do	25–30. 5	do	do	Harrisson (*33*)	7 observations.
Do	23–43	do	do	Roberts (*63*)	6 observations.
Do	35	do		Aymar (*10, p. 135*).	
Do	28.4–51.4	Stop watch	Scotland	Campbell (*16*)	When driven by a gale made 98.18 m. p. h.
Do	43–49	do	India	Meinertzhagen (*49*).	13 observations, wind calm.
Do	45–48. 5	Theodolites	Palestine	do. (*49*)	22 observations, 120 to 325 feet, wind calm.
Do	46. 5	Stop watch	Germany	Thienemann (*69*)	Single bird.
Do	35–40	Boat	North Sea	Clarke (*20, v. 2, p. 30*).	Migrating birds.
Do	28, 35	Automobile		Wood (*84*)	2 observations.
House sparrow	32–33	do	England	Harrisson (*33*)	Faster bird chased b car.
Do	24	do	do	Ticehurst (*70*)	
Do	28, 35	do		Wood (*84*)	2 observations.
Meadowlark	20	do		do. (*84*)	
Western meadowlark.	40	do	California	Tyler (*71*)	200 yards, low direct flight.
Red-winged blackbird.	22–23	do		Wood (*84*)	3 observations.
Do	28	do		Aymar (*10, p. 135*).	
Tri-colored blackbird.	46–52	do	California	McLean (*45*)	46 to 48 m. p. h. to and from nest, flock flew at 52 m. p. h.
Baltimore oriole	12	do	Kansas	Wood (*83*)	
Do	26	do	New England	White (*78, v. 44*)	
Bullock's oriole	28–32	do	Washington	Rathbun (*61*)	
Rusty blackbird	19–23	do		Wood (*84*)	4 observations.
Brewer's blackbird.	27–38	do	Washington	Rathbun (*61*)	Flock.
Boat-tailed grackle	28	do		Aymar (*10, p. 135*).	
Bronzed grackle	27, 30	do	New England	White (*78, v. 44, 46*).	2 observations.
Do	20–28	do		Wood (*84*)	8 observations.
Indigo bunting	20	do	New England	White (*78, v. 46*)	
Goldfinch	16, 18	do	do	do. (*78 v. 50*)	
Crossbill	37. 1	Stop watch	Germany	Thienemann (*69*)	Average of 2 observations favoring wind.
Savannah sparrow	37–42	Automobile	California	McLean (*45*)	Higher speed the limit.
Vesper sparrow	17	do	New England	White (*78, v. 44, 46*).	2 observations.
Slate-colored junco	18	do		Wood (*84*)	
Chipping sparrow	15–20	do	New England	White (*78, v. 50*)	3 observations.
Song sparrow	17	do	do	do. (*78, v. 44*)	
Snow bunting	16. 7	Ship	North Atlantic	Alexander (*8*)	Flock in migration, 250 miles from land, flew with ship ¼ hour.

RUNNING SPEEDS

Valley quail	12	Automobile	California	Hunt (*36*)	Pressed to their utmost.
Do	14. 5	do	do	McLean (*46, p. 5*).	Stride 12¾ inches; badly frightened.
Gambel's quail	15. 5	do	do	do. (*46, p. 5*)	For 75 feet, stride 13 inches.
Mountain quail	14. 5	do	do	do. (*46, p. 5*)	For 100 feet, stride 13½ inches; apparently not badly frightened.
Road-runner	10	do	do	Hunt (*36*)	
Do	15	do	do	Sheldon (*65*)	300 yards top speed; bird seemed much fatigued.
Do	20	do	do	Smith (*67*)	Without trying to dodge could increase to 22 m. p. h., but soon dropped back.
Emu	31	do	Australia	Le Souëf (*43*)	Driven for 10 miles, would not increase speed.

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